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Notes on North American Willows. IV.

M. S. BEBB.

1. SALIX ARCTICA Pallas. Flora Rossica, vol. 1, pt. ii, p. 86. *S. crassijulis* Trev. ex Traut. Sal. frigid. p. 308. *S. diplodictya* Traut. l. c. p. 307. *S. Pallasii* Anders. DC. Prod., vol. 16, pt. ii, p. 285.

2. S. BROWNII. *S. arctica* R. Br. Bot. Ross Voy. 2 ed., vol. 2, p. 194. Melv. Isl. Pl. p. cclxx. 11 (not Pall.). Hook. Fl. Bor.-Amer. ii, p. 152. Ledebour, Fl. Ross. ii, p. 86. Icon. Fl. Ross. Tab. 460. Anders., DC. Prod., 16. 2. 286 (excl. var. *nervosa*).

Salix arctica Pallas was published in 1788. The species is a very peculiar one, of striking features, easily recognized, and the description given is graphic and wholly free from ambiguity. In the Botany of Ross' Voyage, London, 1819, Robert Brown printed in a list as a new species his *S. arctica*, the description of which was published in the *Chloris Melvilliana*, List of Plants collected in Melville Island under Capt. Perry, London, 1823. The earlier *S. arctica* of Pallas appears to have been unknown to Brown; at any rate he makes no reference to it. With the exception of Ledebour, who misapprehended *S. arctica* Pall., and united with it as a synonym *S. arctica* R. Br., the fact came to be recognized by well informed botanists that the name *S. arctica* had been given to two distinct species. Both names continued to be sustained, one by its manifest priority, the other by the preponderating authority of Robert Brown. The species were distinguished in each instance by citing one author and excluding the other. Thus it was *S. arctica* Pall. (not R. Br.) or *vice versa*, *S. arctica* R. Br. (not Pall.) This state of things continued unchanged down to the time when Andersson's revision of the entire genus for De Candolle's *Prodromus* precipitated the suppression of one or the other of the two names. The older species now received the name of *S. Pallasii* And., and the authority of Pallas was carried over and imposed upon *S. arctica* R. Br. *S. arctica* Pallas became *S. Pallasii* n. sp., and *S. arctica* R. Br. became *S. arctica*

Pall.: the two species (aside from the shifting of names) standing in the same relation precisely as heretofore. Had *S. arctica* Pall. been written down a synonym of *S. Pallasii*, and *S. arctica* R. Br. been left intact, some degree of consistency could be urged in behalf of an author who throughout pays little or no regard to claims of priority. It might be argued that *S. arctica* R. Br. was so deeply embedded in the science that it could not and ought not to be torn out by the roots, and that it were better, since one of the two names must be suppressed, that the more obscure—even if confessedly the older one—be sacrificed. Any such apology, however, is felt to be out of place when we have a new name given to the old *S. arctica* Pall., the authority of Pallas transferred to a species of which he was entirely ignorant, and Robert Brown left out entirely.[1]

But we are not obliged to rest our judgment solely upon the characters given, though in the present instance this evidence is in itself conclusive. Not only does the name, *S. Pallasii*, imply the earlier description by Pallas, but we have *Andersson's own admission* that he had seen the specimens of Sujef (type of *S. arctica* Pall!) "in the herbarium of Pallas, inscribed *S. arctica*," and that these did not differ from his *S. Pallasii*, var. *diplodictya!*

The venerable Dr. Trautvetter, whose special study of arctic willows and whose familiarity with the work done on Salix by Russian botanists, must combine to give his opinion a weight beyond that of Andersson's, writes in a letter: "*S. diplodictya* differs from *S. crassijulis* (*S. arctica* Pall. not R. Br.), only in the leaves green and shining beneath, and it may be questioned if the species is well founded." Here, in a brief sentence, we have the pith and substance of the

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[1]

S. arctica Pall.	*S. Pallasii* et *a. crassijulis* And.
"Folia pro planta majuscula	"Folia supra medium
pollice latiora,	pollice latioribus,
obovata,	obovatis,
apice latiora rotundata,	apice rotundatis,
integerrima,	integerrima,
crassius reticulata,	distincte reticulato-nervosis,
subtus tenuissime villosa,	subtus sericeis,
amenta feminea magna bipollicaria, digiti minimi crassitie	amentis femineis fere bipollicaria, crassiusculis,
e lateribus ramorum,	lateralibus
longius pedunculata duobus,	pedunculo superne sat
tribusve foliis majusculis	longe nudo inferne
stipata,	foliis 2-3 instructo,
capsulæ conicæ,	capsulis conicis,
tomentosa-canæ." Flora Rossica.	longe cinereo villosis." DC. Prod.

"Capsulæ confertæ," Pall., and "amentis densifloris," And.—meaning the same—could not be conveniently arranged opposite each other in the schedule.

Pallas died 1811, twelve years before *S. arctica* R. Br. (based upon specimens brought home by British explorers) was published.

whole matter. 1. That *S. diplodictya* is not distinct from *S. crassijulis*; 2. that *S. crassijulis* is synonymous with *S. arctica* Pall. (which is the main point); and finally, 3, the familiar assertion that the *S. arctica* of Pallas *is not* the *S. arctica* of Robert Brown—a statement which can not be made too emphatic, in view of the placid acquiescence, for years past, in the dictum of Andersson to the contrary.

It is to regretted that a name grown so familiar as that of *S. arctica* R. Br. must needs be disturbed; on the other hand, *the open fact of the priority of S. arctica Pall. can not be ignored*, and as what Sir William J. Hooker was wont to call "Mr. Brown's S. arctica" was only sustained by the constant mention of the name of the distinguished author, let us hope that the substitution of this name for the one preoccupied may in a large measure preserve unbroken the old associations.

Rockford, Ill.

The Diatom marshes and Diatom beds of the Yellowstone National Park.

WALTER H. WEED.

It is well known that the minute algæ, to which the name of diatoms has been given, possess, in a remarkable degree, the power of separating silica from solution in the waters in which they live. This action is the more remarkable because the silica is often present in such exceedingly small amounts that an almost inconceivable activity on the part of the plant is required to obtain an adequate supply to form their frustules, while the separation of the silica must itself be referred to some vital force exerted by the plant during its growth. It is this action which gives to this low form of life its importance as a geological agent.

As the Diatomaceæ exist under very diverse and extreme conditions of environment, occurring in the icy waters of polar seas, the heated currents of the tropics, and even in the almost boiling waters of hot springs, they are in consequence the most widely distributed form of life known, and their common occurrence in ponds and ditches is well known to every microscopist. Nevertheless, contemporaneous deposits formed of their remains are usually small in comparison with

the immense beds of Tertiary age, which occur in many parts of the world.

In the prosecution of geological work in the Yellowstone National Park, the writer has found that diatom beds of recent origin cover many square miles in the vicinity of the geyser and hot spring basins. These deposits, which are among the largest fresh water diatom beds of contemporary age known, are still forming by the growth of diatoms in the warm water marshes supplied by the hot spring waters.

These diatom marshes are sure to be remembered by all who may attempt to cross them, for the treacherous surface and apparently bottomless depths of the ooze offer an effectual barrier to any progress in that direction.

Near the Emerald springs at the Upper Geyser Basin of the Firehole river, the most noted geyser region of the park, there is a typical marsh of this character. The waters have in times past encroached upon the neighboring patch of timber, killing the pines (Pinus Murrayana), whose bare, gray trunks stand upright in the ooze or lie scattered about half immersed beneath the waters of the marsh. A subsequent partial recession of the water has left a bare, white strip between bog and wood, on which vegetation has as yet a feeble hold, and the gaunt poles of the dead pines stand in a white powdery soil that is evidently a dried portion of the marsh mud. A large part of this bog is covered with a sparse growth of brackish water plants, and the drier parts are grass grown and form a fairly firm meadow bottom. The greater portion consists, however, of a semi-liquid, greenish gray, dirty looking ooze. Under the microscope this was found to consist of beautiful siliceous tests of various species of diatoms. Samples of this material, which Mr. Francis Wolle has kindly examined for me, were found to contain the following species:

Denticula valida	Epithemia hyndmannii
" elegans	Cocconema cymbiforma
Navicula major	Achnanthes gibberula
" viridis	Mastigloia smithii
Epithemia argus	Fragillaria—
" " var amphicephala	

The first species named, Denticula valida, was the most abundant, forming the bulk of the specimen. It may be of interest to note here that this species has been found in the gatherings from the geyser basins of Iceland.

The white pulverulent material at the margin of the bog

proved, upon microscopic examination, to consist of the dried remains of these same diatoms, and it is quite evident that this diatom ooze is forming a bed of diatomaceous earth. Subsequent investigation proves that a diatom ooze, consisting of the same species, forms the chief constituent of similar marshes all over the park.

It has also been found that the meadows of the geyser and hot spring basins were once marshes of this character, and are underlaid by beds of soft straw-colored or gray material which consists of the partially dried remains of diatoms. This material when dried is white, loosely coherent, soils the fingers, and consists either entirely or very largely of diatom tests. A number of specimens of this material collected from the Norris, Lower and Upper Geyser Basins, and the hot spring areas of Pelican Creek, were examined by Dr. Wolle, and found to consist of the species already named, forming a diatomaceous earth that is sometimes very pure, and sometimes mixed with more or less glassy silica formed by the drying of the siliceous jelly with which these organisms so often surround themselves.

These diatom beds cover many square miles in the vicinity of active or extinct hot spring vents of the park, and are often three feet, four feet and sometimes five to six feet thick. The wagon road leading to the geyser basins crosses several meadows of this character, notably immediately south of the Norris basin, Geyser meadows, and the meadows of the Upper and Lower basins of the Firehole. At these places the beds are exposed in the cuttings made for drainage, and square blocks of the dried diatom earth lie scattered about at the sides of the road.

In most of the cases observed, these diatom marshes cover ancient deposits of siliceous sinter, diatoms growing in the cooler waters of the decaying springs or their overflow, and covering the sinter beds until even the tops of the cones are submerged beneath the ooze and the vegetation it supports. This is actually the case at several places in the Lower Firehole Geyser Basin, and at the Lewis Lake and Pelican Creek hot spring areas. Such marshes also occur, however, where the cooler alkaline waters of the geysers and boiling springs overflow the natural surface of the ground.

The diatom ooze thus far observed is from cool or tepid waters, but in the collection of algæ from the hot springs of the park, and placed in the hand of Prof. W. G. Farlow for study and description, specimens of Denticula thermalis (Kg.)

have been found, and Mr. W. P. Blake found diatoms in the hot waters of the so-called "geysers" of California and Nevada hot springs.

U. S. Geological Survey, Washington, D. C.

Flowers and Insects. I.

CHARLES ROBERTSON.[1]

Delphinium tricorne Michx.—The flower agrees in most respects with D. elatum, as described by Müller.[2]

It is blue, but the exposed parts of the two upper petals which arch over the entrance to the spur are white, forming a sure guide to the nectar. In D. Ajacis, according to Sprengel (702),[3] the upper petals also form the pathfinders by a variation in color. In D. elatum yellow hairs on the lateral petals form the guides, while in D. Consolida pathfinders are wanting (Müller).

The lower petal has disappeared, since its attractive function has been usurped by the sepals. It is unnecessary as a protection to the stamens and pistils, and its presence in the median line would only prevent proper contact with the anthers and stigmas.

The parts whose function has been most imperfectly explained are the two lateral petals. These close over the numerous stamens, completely hiding them, but an entrance to the spur is left between them and the upper petals. When a bee visits the flower, the lateral petals are forced aside, and the under side of the bee's head comes in contact with the

[1] The following series of papers is intended to give the results of observations begun in 1886, near Carlinville, Ill. It has been necessary at first to pay particular attention to collecting and determining the insects. Accordingly, in case of many flowers I am able at present to give only a list of visitors.

Mr. Cresson has compared my bees with his own type specimens in the collection of the American Entomological Society, except species of Halictus and Andrena. Professor S. W. Williston has kindly identified the Diptera. Mr. C. A. Hart and Mr. Samuel Henshaw have aided me in identifying the Coleoptera. Prof. G. H. French and Mr. Hart have named a number of Lepidoptera for me. I am also under obligations to Prof. S. A. Forbes for access to the collections and literature of the Illinois State Laboratory of Natural History, and to Prof. William Trelease for access to his valuable index of the bibliography and to much of the special literature of fertilization. Prof. Trelease has also placed at my disposal his unpublished notes on the subject and a collection of insects which he has taken on flowers.

[2] Unless otherwise specified, all references to Müller are to Herman Müller: Fertilization of Flowers. See also on this species Delpino: Ulteriori Osservazioni, and Lubbock: British Wild Flowers.

[3] The numbers in parenthesis after an author's name refer to Thompson's bibliography of the literature of fertilization, which is printed with Müller's Fertilization of Flowers. As this book is the most important source of information on the literature, references are practically thrown away on all who do not have access to it.

anthers and stigmas. The use of these petals seems to be to protect the pollen from intruders. Sprengel saw bees collecting pollen of D. Ajacis, and I have seen a very abundant and useful visitor, Synhalonia speciosa, collecting pollen of D. tricorne, but I am convinced that they behave improperly in so doing. Humble-bees, which are best adapted to fertilize the flowers, never gather pollen. On the other hand, I have seen Andrenidæ trying to collect it, and they were only hindered by the lateral petals. But for these petals most of the pollen would be carried away by little bees which would only visit flowers in the male stage.

The spur of the upper sepal is crumpled, and sometimes fits the spurs of the petals so loosely that its tip is empty and hangs down. Indeed, in one case I found the upper sepal entirely empty, and the spurs of the petals stood in front of its lamina. Delpino (178) regards the spur of the sepal as a protection against the jaws of insects which might attempt to cut a way to the nectar, but both he and Riches[1] found some species of Delphinium to be perforated.

As in D. elatum, the spurs of the petals are entire at the tips and open below into a common cavity. The nectar, therefore, is held in two receptacles, and I have observed that when Bombus and Synhalonia insert their proboscides into the spur, they regularly draw back a little and thrust their tongues in again, evidently to extract the nectar from both petals. I think the double nectary is to favor bees, which are intelligent enough to drain both sides, while butterflies will probably leave one side full. This structure might also be of advantage in case of perforation, since the robber would have to make two holes or leave one side full. The double nectary, however, causes delay, and this seems to be the reason why the nectariferous petals of D. Consolida have developed a common cavity throughout.

D. tricorne agrees with the other species which have been studied in being male in the first stage and in being specially adapted to humble-bees.

The spurs of the petals from the point of insertion to the closed part measure from 7 to 9 mm., and to the tips from 15 to 17 mm., so that a proboscis 7 to 9 mm. long is needed to reach the nectar, and one 15 to 17 mm. long to exhaust it. Only the females of Bombus are flying while the plant blooms. B. Pennsylvanicus, with a tongue 16 to 17 mm. long, is best adapted to suck up all of the honey.

[1] Science Gossip, 1877, 249.

Müller found D. Consolida visited by Bombus hortorum and lapidarius. He also found butterflies, Satyrus and Hesperia, stealing honey, and I have found a still greater number on this plant. The presence of these insects on bee-flowers is always important, since it enables us to understand how many flowers which originally must have been adapted to bees have been modified to suit butterflies. The white-flowered form of this plant might easily become adapted to hawk moths.

Müller found D. elatum visited by Bombus hortorum and Anthophora personata.

On six days between May 4 and 13, I caught the following insects on the flowers. Nos. 4 and 6 are characteristic visitors, while 8–18 are intruders:

Hymenoptera—*Apidæ:* (1) *Bombus virginicus* Oliv. ♀: (2) *B. separatus* Cress. ♀ (11–13)[5]; (3) *B. vagans* Sm. ♀: (4) *B. pennsylvanicus* De G. ♀ (16–17): (5) *Anthophora abrupta* Say ♂ (14); all sucking; (6) *Synhalonia speciosa* Cress. ♂ ♀, s. and c. p.; (7) *S. atriventris* Sm. ♂, s.; (8) *Ceratina dulpa* Say ♀ (5–6) crawling into lower part of spur whence it may reach a little nectar. *Andrenidæ:* (9) *Agapostemon radiatus* Say ♀: (10) Halictus sp. ♀, both trying to collect pollen.

Lepidoptera—*Rhopalocera:* (11) *Danais archippus* F.: (12) *Papilio asterias* F.: (13) *P. troilus* L.; (14) *P. turnus* L.: (15) *Colias philodice* Godt.: (16) *Pamphila zabulon* Bd.-Lec.; (17) *Eudamus tityrus* F. *Sphingidæ:* (18) *Deilephila lineata* F.

Nuphar advena Ait.—On the first day the anthers are closed, and are crowded in a compact mass under the edges of the broad stigma. Their fleshy tips keep them from being gnawed by beetles. The petals also protect the lower anthers from gnawing-insects, and secrete nectar on their outer faces. At this time the stigma is receptive, and the flower is therefore proterogynous. The yellow sepals separate so as to leave a triangular opening over the stigma, so narrow that insects can not enter the flower without crawling over the stigmatic surface.

On the second and one or two succeeding days the anthers are dehiscent. The sepals then are often so widely separated that insects are no longer required to come in contact with the stigma.

[5] The numbers after an insect's name indicate the length of the proboscis in millimetres.

In Illinois in August, and in Florida in February, I found the flowers visited by the same species of insects, *Halictus pectoralis* Sm. ♀ (Andrenidæ), and *Helophilus divisus* Loew (Syrphidæ). In Florida I also found it visited by a fly, *Notiphila* sp. (Ephydridæ), and a beetle, *Donacia piscatrix* Lac. (Chrysomelidæ). The beetles were abundant on the older flowers, where they were pairing, the females gnawing the petals and anthers. I tried to catch the visitors by holding my net over the flowers and shaking the stalks, which only made the bees lie more closely, and for awhile I thought visitors were very scarce. Finally, I picked many flowers, and, bending back the sepals, found an Halictus under the petals of most of them, especially the new flowers. All of the bees taken on new flowers were well dusted with pollen from older flowers.

At Madison, Wisconsin, Prof. Trelease (MS. notes) also found it visited by Halictus pectoralis and Donacia piscatrix.

Sprengel (702) found N. luteum visited by beetles of the genus Meligethes. Müller also found it visited by Meligethes, and by Onesia floralis (Muscidæ) and Donacia dentata.

Delpino (178) regards N. luteum as adapted to beetles, but I find no evidence of such adaptation in N. advena; the beetles which occur I regard as worse than useless. However, beetles of the genus Donacia are very fond of the flowers of Nuphar, since they were observed on them by Müller in Germany, by Trelease in Wisconsin, and by me in Florida.

Figures of N. luteum in Hooker's edition of Le Maout and Decaisne's Botany, 208, and in Sprengel, Pl. XXIII, indicate fairly well the male stage of N. advena. I see nothing to lead insects to touch the stigma when the flower is so widely expanded. Indeed, Sprengel says: "Bei der Nymphæa hingegen ist es ein blotzer Zufall, das die Blumenkäfer den Antherenstaub auf das Stigma schleppen," and he regards this as an explanation of the large size of the stigma. Pollination seems so uncertain in such a flower as to incline one to doubt whether it is intended to occur when the flower is so widely expanded.

Nymphæa tuberosa Paine.—In Southern Illinois this plant blooms from May until October. The flowers open in the morning sun and close in the afternoon.

On the first day the flowers are not widely expanded, looking like buds at a distance, and the first stage is likely to be overlooked. The petals stand close together, leaving but

a narrow entrance. The stamens stand in a compact circle close to the petals, and the anthers are indehiscent. The filaments vary from the outer, which are long and broad, to the innermost, which are short and slender. The claw-like scales which surround the concave stigma form with it a little bowl, which holds a large drop of water. At this time the stigmatic papillæ are well developed, and the flower is evidently in the female stage.

On the second morning the water has disappeared from the stigmatic basin, and the papillæ look dry and shrivelled. The claw-like scales are curled in strongly over the stigma, and the inner stamens, which are now dehiscent, have fallen over it, so as completely to hide it. The outer stamens are turned outward, and the petals are widely expanded.

Of eight flowers which were marked, four opened on three days and four on four days. One of the latter had some anthers still closed at noon of the fourth day, promising to open again on the fifth. The flowers are therefore female on the first day and male for two or three days after. It follows that, when about the same number of new flowers open daily, there will be two or three times as many in the male as in the female stage.

All of the insects which I saw on the flowers were in search of pollen, which the numerous stamens yield in abundance. Insects coming from the old flowers drop into the new ones, and plunge into the stigmatic basin. If, in their attempts to escape, they trust their weight to the inner stamens, these bend so suddenly as to throw them again into the water. If the insect does not drop into the stigmatic basin, but lights on the stamens, the slender filaments act like the lip of Calopogon and let him down upon the stigma.

The water on the stigma seems to be intended to loosen the pollen from the scopæ of bees which have been collecting it on the older flowers. I have not discovered any sweet taste in the water, nor have I seen insects attracted by it. Moreover, it seems to be present in too great quantity for the purpose of nectar. Indeed, when insects are thrown back repeatedly into it, they may be drowned. I have seen Agapostemon radiatus and Halictus occcidentalis drowned in the same basin.[6]

If my interpretation is correct, the flower is remarkable

[6] A. Bacon (Torr. Bull. V, 51) found dead insects in flowers of N. odorata, which he supposes were captured by the flower closing up. Delpino (178) also found dead insects in N. alba, and considers their death as a result of the heavy odor of the flower. Planchon (Flore des serres et des jardins, 1850) thinks it a result of the accumulation of carbonic acid in the bottom of the flower

for having perfected a proterogynous condition, although visited exclusively for pollen. Even when nectar is present, many insects in search of pollen only visit dichogamous flowers in the male stage. We have observed that most of the flowers are discharging pollen, so that insects drop carelessly into them and are evidently surprised when they find themselves in the stigmatic basin of a new flower. Attracted by the abundant stamens, they do not discover their mistake before they touch the stigma. However, I have sometimes seen Halictus pectoralis turn away from a new flower into which it was about to drop, and fly to an old one.

On ten days between May 22 and September 18, I took the following insects on the flowers: Hymenoptera—*Andrenidæ:* (1) Agapostemon radiatus Say ♀, c. p., ab., sometimes drowned; (2) A. nigricornis F. ♀, c. p., ab.: (3–4) Halictus spp., ♀, c. p.: (5) H. pectoralis Sm. ♀, c. p., ab.: (6) H. occidentalis Cress. ♀, c. p., sometimes downed: (7) H. coriaceus Sm. ♀, c. p. do.: (8) Prosopis sp. ♀, c. p.

Diptera—*Syrphidæ:* (9) Helophilus divisus Lw. c. p., ab.; (10) H. latifrons Lw., c. p. *Bombylidæ:* (11) Sparnopolius fulvus Wied.

Coleoptera—*Rhipiphoridæ:* (12) Rhipiphorus limbatus F., drowned.

Nymphæa odorata L.—The flower resembles N. tuberosa, and is likewise female in the first stage. In Florida, in February, I have seen it visited by Halictus pectoralis Sm. ♀.

Delpino (178) regards Nymphæa as specially adapted to beetles. He states that Piccioli found N. alba abundantly visited by Donacia.

Dicentra Cucullaria DC.—The flower is figured and its mechanism described by Hildebrand (358). A peculiar interest surrounds it from the fact that its time of blooming is correlated with the appearance of long-tongued bees, and in my neighborhood it is the first flower adapted to them. In April, 1886, the first open flower was observed on the 7th, with no visitor. April 9, I found hive-bees collecting pollen and Papilio ajax sucking. April 11, hive-bees were collecting pollen, Bombylius, butterflies and the first humble-bees were sucking. On the 12th, humble-bees were present in considerable numbers for the first time, so that it required six days for the proper insect relations to become established.

The two inner petals are united over the anthers, protect-

ing them from insects which are in search of pollen, so that the flowers are only adapted to be visited for honey. But the hive-bee visits the flower only for pollen, and I have seen no better illustration of its ingenuity than its success in gathering it. With its head it pushes aside the inner petals, partly separating them, while it removes the pollen with its front feet.

The pendulous position of the flowers makes them inconvenient for all visitors except bees (and Bombylius), but butterflies sometimes hang under the flowers and steal some of the nectar.

The nectar is secreted by two long processes of the middle stamens, and rises to the tip of the spur. A proboscis about 8 mm. long is necessary to reach it, and one 12½ to 14 mm. to obtain all of it. The females, which have longer tongues than the males and workers, are the only individuals of Bombus which fly while this plant is in bloom, and since the shortest-tongued of them can easily reach the nectar, it is strange that any should ever be guilty of cutting holes in the flowers. I have seen many individuals of four species sucking, but never perforating. However, the flowers are sometimes perforated by humble-bees (?), according to Leggett, Bailey, Stone and Merriam[7]. One observer states that humble-bees made the holes, and that honey-bees were sucking. The honey-bee's tongue is only 6 mm. long, and can hardly reach any of the nectar, and although I have seen this bee collecting pollen very often, I have never seen it sucking. His honey-bee was evidently a Synhalonia.

Observed on ten days, between April 9 and 30. Nos. 2–12 are proper visitors, the rest intruders. Hymenoptera–*Apidæ:* (1) Apis mellifica L. ☿, c. p.; (2) Bombus virginicus Oliv. ♀; (3) B. separatus Cress. ♀; (4) B. vagans Sm. ♀; (5) B. pennsylvanicus DeG. ♀; (6) Anthophora ursina Cress. ♂; (7) Habropoda floridana Sm. ♂; (8) Synhalonia atriventris Sm. ♂; (9) S. honesta Cress. ♂ ♀; (10) Osmia latitarsis Cress. ♂; (11) O. montana Cress. ♂; (12) O. lignaria Say ♂ ♀.

Diptera–*Bombyliidæ:* (13) Bombylius fratellus Wied., sometimes on cold days the exclusive visitor.

Lepidotera–*Rhopalocera:* (14) Danais archippus F.; (15) Pyrameis atalanta L.; (16) Papilio ajax L.; (17) Pieris rapae L.; (18) Nisoniades martialis Scud., all sucking, except 1.

[7] See Pammel: Trans. St. Louis Acad. Sci., v. p. 274.

Notes on the flora of Iowa.

A. S. HITCHCOCK.

Iowa can not boast of a flora remarkable for its diversity. It contains no mountain ranges, no arid deserts, no sea coast, extended lake shore or dreary swamp. It is essentially a prairie state, but is not included in that vast and characteristic region known as the "Great Plains." It lies on the western border of what is known as the "Manual region." Of the phænogamous plants recorded for Iowa (about 1,300 species and varieties), there are not more than forty that can not be found in Gray's Manual. Part of these have been described since the manual was written, and are found within the geographical limits covered by this most excellent book. Nearly all the remainder are to be found only in the extreme western part of the state.

Although there are no dense forests in the state, yet the wooded flora is quite diverse. With the exception of conifers, Iowa will compare favorably in this respect with other states having more varied geological characters.

Of the order Coniferæ five species are recorded by Prof. Arthur. I have seen but two, viz., *Juniperus Virginiana* L., in the northern part of the state, and *J. communis* L., which is quite common along the Iowa and Cedar rivers.

The number of species of trees, as well as individuals, increases as one goes south or east from the northwest corner of the state. The oaks increase from three to thirteen. *Populus monilifera* Ait. is replaced by *P. grandidentata* Mx. and *P. tremuloides* Mx. In the southern part are found *Quercus imbricaria* Mx., *Cercis Canadensis* L., and *Asimina triloba* Duval, which are more southern in their range; in the eastern part *Dirca palustris* L. and two species of birch, which are eastern.

The only portion of the state that shows any radical difference from the rest, as regards its flora, is the western border, the bluffs along the Missouri river.

From Hamburg, in the southwestern part of Iowa, to Sioux City, where the river leaves the Iowa line, we find the bluffs extending like a miniature range of mountains, as seen from the river, sometimes with the muddy Missouri flowing at their base, and again several miles away.

At Hamburg they are five miles back, but rise precipi-

tously to a height of 100 or 200 feet, so steep, in many places, that one could not ascend were it not for the terraces. In most places the side of the bluff is devoid of trees, although often wooded at the summit and further back.

The flora of the plains has crossed the river and obtained a firm foothold upon this narrow strip of land, not more than a few hundred feet in width. Many of the plants so plentiful on the bluffs are not found further east, except as strays.

As examples of this flora I will mention *Houstonia angustifolia* Mx., *Yucca angustifolia* Pursh., *Gaura coccinea* Nutt., *Dalea laxiflora* Pursh., *Oxytropis Lamberti* Pursh., and *Astagalus lotiflorus* Hook., var. *brachypus* Gr. The last named species has not before been recorded for the state. It was kindly determined for me by Dr. Sereno Watson.

Two aquatic plants of a more southern range, and both new to Iowa, were found in this most interesting region, *Heteranthera limosa* Vahl and *Echinodorus rostratus* Eng.

At Sioux City we find a more typical prairie region. Trees are scarce, except on the low land near the river. The flora here is quite as interesting as at Hamburg, and several "finds" were made.

Early one morning I started out to conquer the Sioux City flora. Being in a conquering mood my first duty was to climb to the top of a steep and arid bluff which looked as if it might bear some hidden treasure to reward the first comer who should dare to scale its lofty heights, and indeed I was rewarded for my labor by finding two plants new to the state, *Linum rigidum* Pursh. of the plains, and *Stipa comata* Trin. of the Rocky Mt. region. I have Dr. Vasey to thank for the latter name. *Aplopappus spinulosus* DC., *Grindelia squarrosa* Duval, and *Liatris punctata* Hook., were also found here.

Having espied a promising sandbar in the distance I descended to the river. I had not tramped over the sand very far before I noticed, here and there, some trees with shining leaves. Thinking they were willows I prudently passed by on the other side. But finally I was brought face to face with one of the little trees and found it covered with small red berries. My willow was *Shepherdia argentea* Nutt. Not supposing it to be thorny I began boldly to capture specimens. I was quickly brought to grief, however, for although it has no true thorns, yet its sharp and stunted branchlets act just as defensively. This species has not been reported before, and undoubtedly wandered down the river from the northwest, where it abounds.

Another interesting plant here was a very woolly thistle, which was a puzzler. I sent it to Dr. Watson, who says it is *Cnicus altissimus* Willd., var. *filipendulus* Gr., remarking that it was near *C. undulatus* Gr. The range given for this in the Synoptical Flora is Texas to Colorado. According to that it had strayed a considerable distance from its home.

Another plant was found the same forenoon, which is worth mentioning, namely Salsola Kali. It was very abundant, but apparently introduced, probably from the northwest, where, I believe, it is found.

As the Spirit Lake region is pretty well known to any who would be interested in Iowa flora, I will not describe it.

At the south end of Lake Okoboji the beach runs directly to the prairie. Walking back a few rods, I came to a patch of grass which I decided was *Agropyrum violaceum* Lange. But Dr. Vasey, on seeing the specimens, decided differently. He said it was *A. unilaterale* T. & S. A. violaceum had been admitted to the Iowa flora on some specimens contributed by Mr. R. I. Cratty, of Armstrong, Emmet county. I wrote to Mr. Cratty, who has contributed largely to the Iowa flora, and he very kindly sent me a specimen of his A. violaceum, which seems to be identical with A. unilaterale, in which case the former must be expunged from the list of Iowa plants and the latter added.

In speaking of reported Iowa plants, I refer to Prof. J. C. Arthur's "Contributions to the Flora of Iowa."

Iowa City, Iowa.

BRIEFER ARTICLES.

Nonnea rosea.—Escaped from my garden, this has become rather abundant as a weed in the vicinity, and promises to be one of our earliest spring flowers. We have not had severe weather, but the thermometer has been so regularly below freezing point, that only yesterday (March 17), it was high enough to start chickweed and Draba verna into bloom. The Nonnea is also keeping company. Honey-bees are trying to glean something from all three, though, later in the season they neglect them for better fare.—THOMAS MEEHAN, *Germantown, Pennsylvania.*

Dicentra stigmas and stamens.—When a half-developed flower-bud is examined the six stamens are seen to have their anthers upon a level with the capitate stigma. Soon after this, and before the petal-tips turn down, the anthers have dehisced and the pollen is in contact with the irregular and roughened surface of the swollen tip of the style. This tip is flat, and suggests the part of a watch key which is grasped by thumb and

finger in turning. Around this irregular and lenticular body the stamens are arranged with one at each narrow edge and two midway upon each side. The two stamens at the edges have each two lobes, while the other four are half stamens. Each pair of half stamens has the two anthers, that is, half anthers, so placed together as to seem like a single stamen. However, each has its filament, which starts from a higher point upon the receptacle than the full-sized stamen and then arches considerably below it. This is particularly evident in Dicentra spectabilis. When the petals are removed the stamens and pistil together have somewhat the appearance of a Jew's-harp. Each bow consists of a single whole stamen filament and the filament of a half stamen upon each side.

Transverse sections through the capitate stigma reveals the fact that there are, in addition to the large protuberances upon the edge of the stigma, a number of small ones over the sides of these protuberances. As the transverse sections show, these small projections extend into the cavities of the dehisced anthers, and as the flower matures the stamens draw down, due to the peculiar arched shape of the filaments or from the prolongation of the style, or both. As a result, the rough surface of the stigma becomes the portion bearing the pollen at the time when the flower is ready for the visitation of insects.—BYRON D. HALSTED, *Rutgers College, New Brunswick, N. J.*

Erysimum cheiranthoides.—This crucifer, not listed in the Michigan catalogue of Wheeler and Smith, I found June 28, 1888, quite abundant on low, muddy ground, near the Au Sable river, Grayling. Although not far from a road, it appeared to be indigenous.

Prof. L. H. Bailey found it growing near Lansing about ten years ago.

C. K. Dodge found it near Port Huron last season, also.

These are the only known localities in the state.—G. H. HICKS, *Owosso, Mich.*

EDITORIAL.

AMERICANS are progressive. They do not fail to remind themselves of the fact often, and in the reiteration quite lose sight of the progress made by the rest of the world in lines little or not at all developed in this country. Why we have almost no botanical gardens, while in Europe all large institutions for higher education and many large cities consider them essential to full prosperity, is worth considering. It is not solely because we are a young nation, for Australia has gardens established in the early days of the colonies which, under the fostering care of municipal governments, have become spots of rare loveliness, and according to the estimate of the people are as useful and profitable as they are attract-

ive. The most notable of the few gardens in our own country is that at Cambridge, and it would be a pertinent inquiry as to what share of credit the garden is entitled in the ascendency of Harvard University, especially as a school of science. But the Cambridge garden has never attempted to advance economic interests or to furnish diversion for visitors; its finances have not permitted such expansion. For some time past the subject of a botanic garden for New York city has been agitated, and with encouraging results. Several of the New York dailies, with medical, gardening and other journals, have advocated it. The movement is, as it should be, under the direction of the Torrey Botanical Club. Besides creating a strong public opinion in its favor, the club has secured the passage of a resolution by the commissioners of public parks for setting aside a suitable piece of ground in one of the new parks, provided a proper endowment fund be obtained within two years. The club considers one million dollars the minimum amount required. To those who know something of the cost of foreign gardens of this sort, the sum will seem small enough. The new garden at Strassburg cost $225,000, and it comes far from being adequate to the needs of a great city like New York. The success of this movement means not only a valuable acquisition for the city and the people who have the opportunity of visiting it, but a great boon to American botanical science. The Torrey Club is entitled to all the support in this great undertaking her fellow botanists can render.

CURRENT LITERATURE.

Peach Yellows.

The large handbooks of plant diseases by the German authors, Frank and Sorauer, present a remarkable array of maladies in the vegetable kingdom, far exceeding the number most persons would suppose possible. But, of the numerous diseases so far recognized, only a very small part has received adequate study, and the number for which acceptable remedies or preventives can be confidently prescribed is astonishingly small. The German works referred to are the only comprehensive treatises of the kind yet published, and still they do not include some of the most prominent and destructive diseases which trouble the American cultivator.

The increasing attention given to the subject in this country, by the cultivator on the one hand, in recognizing the value of the work already done, and by the investigator on the other hand, in more thorough study, particularly of the distinctively American maladies, present a hopeful outlook for this branch of applied science.

Of the strictly American plant diseases probably none has had more prominence, proved so unmanageable and has so effectively baffled all at-

tempts to determine its cause and obtain suitable remedies or even to accurately diagnose, as that of peach yellows. The unusual difficulties which the study of this disease presents, lend much interest to all well directed efforts toward elucidating the subject. The most important paper in this line yet published is that of Mr. Erwin F. Smith,[1] recently issued as Bulletin No. 9 of the Section of Vegetable Pathology of the Department of Agriculture. The practical fruit-grower will doubtless feel disappointed when he looks through this rather thick report, as he will be unable to find answers to the two great questions: "What is the cause?" and "What is the remedy?" But if Mr. Smith has not found the key that unlocks the entrance to the field, he has certainly defined the limits of the field, given a large amount of information regarding the lay of the land, and carefully traced its history, in short has made a comprehensive and lucid statement of the whole subject as it stands at the present time, backed up by a long array of authority.

The report covers the work of sixteen months, far too short a time to institute and conclude much experimental evidence. The results of this part of the inquiry will doubtless appear in a later report. But besides properly assorting the incongruous views of others, Mr. Smith has added valuable knowledge from his own observations, particularly regarding the diagnosis of the disease and its distribution.

There is record of peach yellows occurring near Philadelphia as early as 1791, and it is known that peaches had been in cultivation in this country for more than one hundred and fifty years prior to that time. At first the disease was local, but rapidly became general in the northern Atlantic states and spread westward and northwestward. At present it is scarcely known in the Gulf states or west of the Mississippi, and not at all on the Pacific coast. The author gives an idea of the large amount of capital invested in the peach industry, and the heavy losses which have resulted in many districts from the yellows. The disease is found to be contagious, at least it can be communicated to healthy trees by budding from diseased trees. The author speaks very cautiously respecting the cause, suggesting micro-organisms as highly probable, although he considers that root-aphides and root-fungi have some claims. Much attention is given to the theory of soil exhaustion, so ably advocated by Dr. Goessmann and Prof. Penhallow, but the author finds it faulty and inconlusive.

The illustrations of the report are well selected and well executed, especially the colored ones.

Altogether, both the author and the public are to be congratulated upon the excellence and completeness of this presentation of an economically important and difficult subject. The questions of cause and remedy are yet to be answered, but with the evidence of good work before us,

[1] SMITH, ERWIN F.—Peach Yellows: a preliminary report. 8vo., 212 pp, 9 colored maps, 32 partly colored plates. Washington 1888.

there can be no doubt that if suitable facilities are afforded, the author will make, in due time, an equally valuable contribution to this phase of the subject.

Minor Notices.

IT IS a great gain to botanical science when botanico-chemical questions are treated by an investigator trained in both botanical and chemical methods. Such foundation for work has enabled Dr. W. E. Stone, now of the experiment station of Tennessee, to carry out an interesting and important study of arabinose.[2] This substance is found in gum arabic, but that used was from the gum that exudes from cherry trees. It was found, contrary to the views of other investigators, to belong to a series distinct from that of the true sugars, and unlike them to give a reaction for furfurol when heated with sulphuric acid. The work involved the employment of a method for the pure culture of yeast, and a study of the conditions of a successful fermentation, already referred to in this journal.

AN INTERESTING PAPER on the paleontological history of the genus Platanus, by Prof. L. F. Ward, has recently been distributed as an excerpt from the Proceedings of the U. S. National Museum.[3] It shows that this small genus of only seven existing species was at its zenith in the Cretaceous and Tertiary periods. A prominent characteristic of the archaic forms is the basal lobes of the leaves, now only occasionally met with on young shoots. By means of these lobes and the venation of the leaves the genetic relationship is pointed out between several fossil forms referred to different genera and their living representatives.

M. P. MAURY has prepared an enumeration[4] of the Cyperaceæ collected in Ecuador and New Grenada by André. Previous reports upon other orders have called attention to the richness of the collection of M. André. The present list comprises 58 species, of which two of Cyperus, one of Dichromena, and one of Rhynchospora are new. The paucity of Carices is quite remarkable. The reprint is re-paged, a most reprehensible practice, as it seems to us, and one for which there is not the slightest excuse.

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[2] STONE, WINTHROP E.—Investigations concerning arabinose and some related substances. 26 pp., 8vo. Knoxville, 1889.

[3] L. c., 1888, p. 39, plates xvii-xxii; also abstract in Proc. Am. Assoc. Adv. Sci., vol. xxxvii, p. 201.

[4] MAURY, P.—Les Cypéracées de l'Ecuador et de la Nouvelle-Grenade de la collection de M. Ed. André. Reprint from *Journal de Botanique* for Nov. 16 and Dec. 1, 1888. Imp. 8vo., pp. 14. Paris: J. Mersch. 1889.

OPEN LETTERS.

The Origin of Floral Structures.

I am always glad to receive criticisms of my theory from an opponent, but my reviewer, "R.," somewhat misrepresents me rather than criticizes, for he says (BOT. GAZ. xiii, 324): "The Darwinian theories of natural selection and of cross-fertilization are thus wholly repudiated." My exact words are (*Or. of Fl. Str.* p. 336), "I do not wish the reader to suppose that my theory is altogether in opposition to Mr. Darwin's." I by no means reject natural selection, and even give the result of an experiment showing how a hard Russian wheat when sown thickly with a soft English grain was "selected," as that only carried ears. I adopted the expression "constitutional selection" as best describing that kind. I recognize natural selection as a factor in several ways, but never as *a cause*, and so not having the importance which has generally been attached to it. None of my many reviewers have credited me with denying it, either in England or America, except "R." "R." quotes the Papilionaceæ as opposed to my theory, in having the standard larger than the anterior petals; but this agrees with well nigh all irregular flowers in which the stamens afford the landing place, *e. g.*, Pelargonium (except "the Scarlets"), Rhododendrons, horse-chestnut, Amaryllis, etc. I have attributed this result in part to atrophy of the anterior petals (p. 111) without precluding a certain amount of hypertrophy on the opposite (dorsal or posterior) side (p. 116). "R." must have overlooked what I have written on this as well as on the resupinate labellum of Orchis (p. 107). "R." assumes Verbascum to be a further advance of the Personales. I regard it as an ancestral form and as more nearly approaching the primitive and regular type of flower; for I know of no case where an irregular flower passes into a regular one *except in a peloric condition* (see chap. xiv). This Verbascum most certainly is not. Why "R." calls zygomorphic types "ancient" does not appear. This is one difference of importance between our respective views, in that I ventured to offer my theory as suggestive or as a "working hypothesis" only (p. 3); on the other hand, "R." states his opinions in a very categorical manner, as if they were not open to doubt at all. Thus he says: "Although it is evident that natural selection must act"—why "evident"? why "must"? I agree with Prof. Huxley, who says that a scientist does not know the word "must." If "R." had pointed out *how* natural selection produces a combination of minute characters in all the organs of a flower, including the floral receptacle; and *all* in harmonious correlation with insect fertilization; I should have been glad to have read it (see p. 330) and his review would have been more satisfactory; but merely to say natural selection "must" have brought them about is neither an answer nor a criticism.

I can only add that I am extremely gratified to find that the views of such able naturalists as Prof. Packard, A. W. Hyatt and others to be thoroughly in accordance with my own. I had no conception that neo-Lamarckism was so widely sustained in the United States.

London, England. GEORGE HENSLOW.

I am satisfied to leave the reader with the context of Prof. Henslow's quotation: "Instead, therefore, of using this term (natural selection) as the cause of anything and everything, I prefer to attribute effects to hypertrophy, atrophy, resistance to strains, responsive action to irrita-

tions, and so on. If it be thought that natural selection somehow underlies all this, the reader is at liberty to substitute the phrase; but, I must confess, it conveys nothing definite to my mind, while the others undoubtedly do. I do not wish the reader to suppose that my theory is altogether (sic) in opposition to Mr. Darwin's; for it must not be forgotten that he himself laid great stress on the environment as a cause of variability upon which, when once brought about, natural selection could then act." I understand this to mean that he agrees with Mr. Darwin in ascribing effects to environment, but not in regard to natural selection. The fact that H. denies the advantage of cross-fertilization is sufficient ground for saying that he repudiates natural selection as an explanation of floral mechanisms. I regard natural selection, not as a cause of hypertrophies and atrophies, but as a cause of adaptations, the most important characteristics of organs and organisms. However, I think of natural selection not so much as a cause as a controller of causes. No doubt H. regards heredity as a cause. But heredity can only insure that a given generation shall resemble its progenitors. Natural selection determines who those progenitors shall be. In regard to other reviewers I quote from *Journ. Bot.* xxvi, 313: "Professor Henslow, for example, is a well-known upholder of the principle of evolution: but in the present work he vehemently combats two of the theories which are most closely associated with the great name of Darwin." H. regards a flower as a geologist would regard a hill, *i. e.*, as a resultant of all the forces which have been brought to bear upon it. But organisms resist or avoid the direct effects of their environment, being active in controlling their conditions, or in adjusting themselves to them. In opposition to this view, I hold that many highly specialized flowers, instead of developing to suit their principal visitors, have contracted the parts in front of the receptacle, excluding one set of visitors after another from the landing until the largest bees could only insert their tongues, *e. g.*, Trifolium pratense and Amphicarpæa monoica.

However, from the standpoint of pure Lamarckism, if we admit that insect contact has a given effect, I hold that the theory will not account for the facts of floral structure. If insects leave the perianth altogether, H. claims that the whole perianth atrophies. If they leave the perianth and light upon the stamens, the perianth atrophies below and hypertrophies above. In the case of Papilionaceæ, etc., I claim that at first direct insect contact was equally absent both above and below and had nothing to do with the reduction of one part or with the enlargement of the other. What he calls atrophy-hypertrophy are the things to be explained, and they can not furnish the explanation. The labellum of orchids is also against the theory. My view is that it was developed as a vexillum on the upper side of the flower, and that its enlargement instead of being a result of its use as a landing after inversion is rather the cause of the inversion. Moreover, in my neighborhood, Habenaria leucophæa, visited by hawk-moths, which suck without touching the labellum, has this part as well developed as in Orchis spectabilis, whose labellum forms a landing for humble-bees. What does insect contact have to do with the colored bracts of Euphorbia and Cornus florida, or with the neutral flowers of Hydrangea and Helianthus annuus?

I consider Verbascum a degradation rather than an advance of the Personales. I call the zygomorphic type of Personales ancient, because it is the type of the cohort. Campanula Americana is in the first stage of zygomorphy. The type of the genus Campanula is actinomorphic. But in the case of Verbascum the type not only of the great order of

Scrophulariaceæ, but also of the great cohort of Personales is zygomorphic. In the Campanula the irregularity is limited to the deflection of the style, while in Verbascum it involves both the stamens and petals. I suppose the type of Scrophulariaceæ to have been a flower with a tube long enough to cover the stamens so that insects could not light upon them, and so narrow as to crowd the stamens and style when they changed to the upper wall. The common form is both nototribe and didynamous, but I do not believe that a flower like Verbascum, with rotate corolla and exposed stamens, could develop either of these characters. Delpino regards Mentha as a degraded form of the Labiate type, and I am inclined to think that he is right.

Finally, for a discussion of zygomorphy from the standpoint of natural selection, and for a refutation of Henslow's view that floral organs must have varied simultaneously, see BOT. GAZ. xiii, 146, 203, 224.

R.

Some queer botany.

One runs across some funny botany in doctor books designed for home use! A few days ago I picked up a *vade mecum* of this sort written by an "M. D." who further styles himself "Licentiate of the Royal College of Physicians, Member of the Royal College of Surgeons (London)," with a lot more of high-sounding degrees. Here is what amused me. "*Podophyllum peltatum*. This plant, of the genus *Mandragora* [nothing like being scientific] has been supposed to be the same as that of which we read in the Scriptures as the mandrake. Its fruit, which is round and yellow, like a small orange, is very fragrant and luscious [mawkish, eaten by pigs and boys, *fide* A. Gr.] and is eaten in the East [wonder if that means "down east"] by women desirous of perfect health. The tuberous (?) root is the officinal portion." And this balderdash in a "sixth edition. thirty-third thousand"!

M. S. B.

Persian lilac on Weigela.

Last summer John Thorburn, LL. D., while visiting Yarmouth, Nova Scotia, discovered close to a house a bush of Japanese Weigela rosea on which there was a branch of Persian lilac carrying fine trusses of flowers. The specimens taken are now in our herbarium, and are undoubtedly as mentioned above. The lilac bushes grew at the back of the house and none where the Weigela grew. As Dr. Thorburn is one of our officers and a reliable gentlemen, I mention the circumstance as being noteworthy and solely on his authority.

JOHN MACOUN.

Ottawa, Canada.

Numbers of the Gazette Wanted.

The series of numbers making a nearly complete set of the BOTANICAL GAZETTE, which the editors have generously presented to the Marine Biological Laboratory at Wood's Holl, Mass., is such a valuable acquisition to our library, and is to benefit such a large number of persons that we are very desirous to fill out the set. Are there not among your readers some who can furnish to the laboratory as gifts or for purchase the lacking numbers? We require still: Vol. III, No. 10; Vol. VI, No. 9; Vol. VII, Nos. 8, 9, 11; Vol. VIII, No. 5; Vol. IX, Nos. 10, 11; Vol. X, Nos. 7, 8, 11, 12; Vol. XI, No. 1.

Boston. CHARLES S. MINOT.

NOTES AND NEWS.

DR. OSCAR UHLWORM has retired from the editorial supervision of the Bibliotheca Botanica. His place is to be taken by Dr. Luerssen of Königsberg.

PROF. W. W. BAILEY reports Houstonia cærulea in bloom at Providence, R. I., on March 26th. "my earliest date in twenty-six years." "Forsythia pendula bloomed here out of doors all winter."

F. A. F. C. WENT, whose interesting studies on vacuoles have been noted (see this journal, xiii. 280) has extended his observation on their origin. Most of his previous studies have related to vegetative cells. He has now investigated the reproductive cells of a large number of algae of various widely separated groups. He finds his previous conclusions confirmed. Vacuoles arise exclusively by the division of previously existing ones.

SINCE the notice of his investigations on the origin of the antherozoids of the Characeæ (ante, p. 87) M. Leon Guignard has extended his studies to the antherozoids of the Hepaticæ, Musci, Filices and Fucaceæ. In recent numbers of Comptes Rendus (cviii, 463, 577) he has summarized his results. In the Fucaceæ each antherozoid is simply an ordinary naked, pyriform cell. It is furnished with a nucleus, situated near the "red spot," and with two cilia of unequal length. The body is very large and contains all the protoplasm of the cell. The cilia arise from a ring of protoplasm on the surface of the body which differentiates itself from the rest by becoming hyaline. The nucleus of the antheridium divides by the usual steps into sixty-four daughter nuclei, so that sixty-four antherozoids arise from each antheridium. At the same time the colorless chromatophores multiply to a much greater number. Each nucleus then joins itself to one of the colorless chromatophores. The remainder quickly become yellow or orange. By the time the formation of the antherozoids is complete, however, these have lost their color and been absorbed, while the chromatophore accompanying the nucleus has become the "red spot." In the other plants named above, in all cases the nucleus, and the nucleus alone, forms the body of the antherozoid. The nucleus moves to one side of the mother cell and begins to elongate, the slender anterior end remaining stationary. This elongation continues till two or more spiral coils have been formed. Then a portion of the protoplasm just outside of the nucleus differentiates in the same manner as described above for the formation of cilia. This differentiated portion may be only a band (when the cilia are to be few, as in the Hepaticæ and Musci), or the whole layer, when the cilia are numerous, as in the ferns. The remaining protoplasm is either completely (Hepaticæ) or partially absorbed (Filices). In the latter case a vesicle is formed which encloses minute starch grains and the residue of the protoplasm. The transformation of the nucleus is accompanied by internal modifications which render the spiral body almost homogeneous. It is covered with an extremely delicate hyaline envelope.

DR. SELMAR SCHÖNLAND, of Oxford, has been called to the curatorship of the Albany Museum in Grahamstown, S. Africa.

DR. E. ZACHARIAS has published in the last number of Pringsheim's Jahrbücher (xx, heft 2) some observations on the origin and growth of the cell wall of the rhizoids of Chara, which are very much in the same line as

the recently published investigations of Kohl[1] on the hairs of Borragineæ, Urticaceæ, Cucurbitaceæ, etc., and earlier ones of Krabbe[2] on bast fibers. The earliest appearance either in the case of a new wall or a thickening layer, is a great number of swarming particles which quickly change into a rodlet structure. This consists of a series of very short rods set side by side, with minute prolongations of the protoplasm between. These rods grow larger and larger and become the solid wall or new layer. All attempts to demonstrate the chemical nature or origin of the first-appearing particles failed. The rodlets give the cellulose reaction. These observations taken in connection with those referred to above make it tolerably certain that there is a form of growth in thickness of the cell wall that is neither apposition nor intussusception, but which consists in the addition bodily of a new structure. And it is quite possible when a new layer is put on in this way that some proteid materials should be included between the older and newer layer. This mode of growth in thickness is quite in contrast with the views heretofore held by Strasburger and others. Strasburger's latest contribution to this subject is just issued and has not yet come under our notice.

Woronin has recently described a disease of cranberry plants produced by the attack of a new species of Sclerotinia, *S. Vaccinii* Wor. The fungus attacks young shoots in spring and makes them yellowish-brown to black, the discoloration gradually extending to the leaves. The conidia are formed in a thick pseudo-parenchymatous swelling which involves the cortex. They are formed by constriction without any transverse wall until after the apical growth of the conidiophore has ceased. Then they are pushed off by a curious device, and carried by the wind or insects to the stigmas of flowers. Here they grow as pollen grains would and fill the cavity of the ovary with hyphæ. From the outer ones branches invade the ovary wall and convert it into a sclerotium. This drops off, withers among the leaves and moss, and as the snow melts in the spring forms fruiting branches. The ascospores are ejected in the same way as in Claviceps and the young shoots are infected toward the end of May. The germ tube penetrates the epidermis wall and reaches the fibro-vascular bundle where it develops as before.

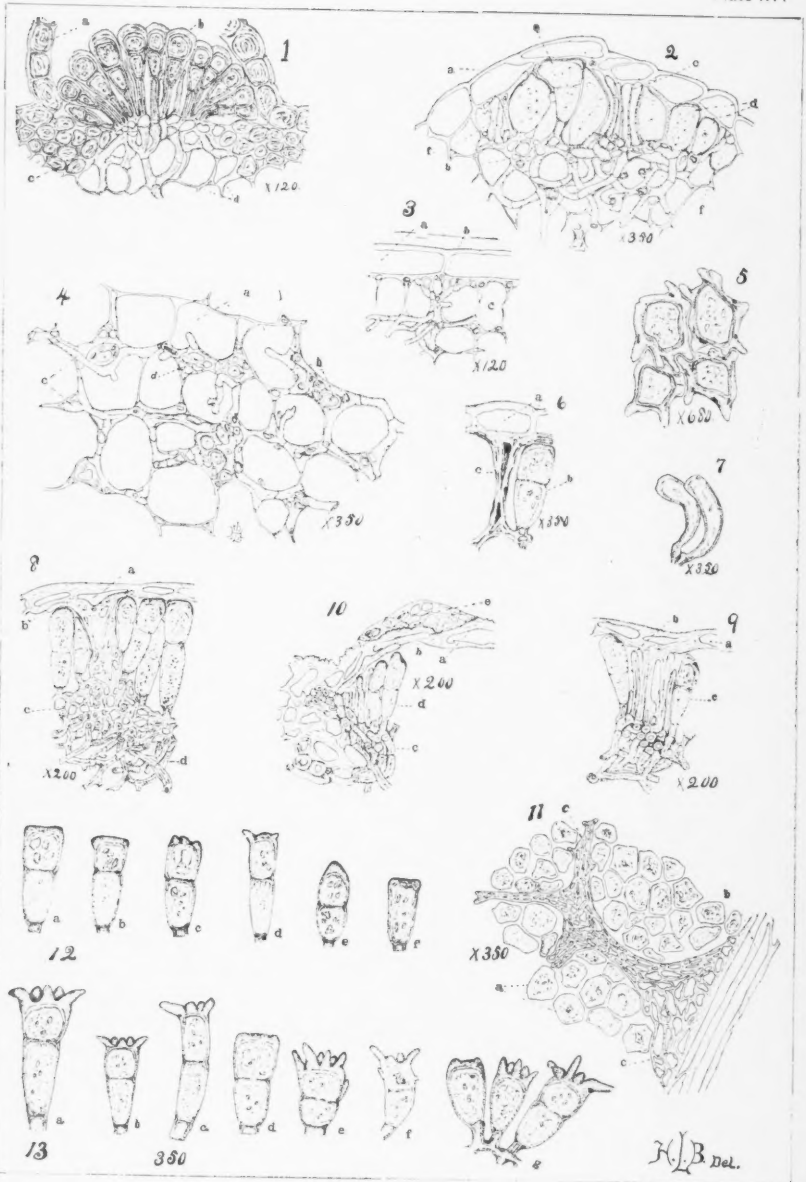
In the February number of the *Journal of the Royal Microscopical Society* Mr. William West gives a list of Desmids collected by Prof. Tyler, near Amherst, Mass. The list comprises eighty-four species and five varieties or forms. Of these two are new species and four new varieties. The paper is illustrated by two plates.

A work on British Uredineæ and Ustilagineæ, by Charles B. Plowright, has been published, and will receive suitable notice in our next number. It is issued at $2.65 (10*s.* 6*d.*), and, after the conservative English method, subscribers (who pay only 8*s.* 6*d.*) are required to forward the price before receiving their copy.

Muscarine, heretofore considered as belonging exclusively to certain poisonous mushrooms, has been detected in a Japanese food, consisting of rice and fish, as a product of decomposition. A case of food poisoning, in which four persons lost their lives, was investigated by Dr. H. E. Stockbridge (Report of the chemist to the Hokkaido Cho, 1888) and the active agent found to be a ptomaine with the properties of muscarine.

[1] Bot. Centralblatt xxxvii. 1.

[2] Prings. Jahrb. xviii. 316.



BOLLEY on SUB-EPIDERMAL RUSTS.